

One new species and two new records in the subgenus *Stegana* (sensu stricto) (Diptera: Drosophilidae) from China, with DNA barcoding information

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Abstract: One new and two known species of the subgenus *Stegana* (s. str.) from China are described or redescribed: *S. (S.) helvipecta* **sp. nov.**, *S. (S.) furta* (Linnaeus, 1767) and *S. (S.) taba* Okada, 1971. A total of 41 DNA sequences of partial mitochondrial cytochrome *c* oxidase subunit I (*COI*) gene of 18 species of this subgenus are newly obtained in this study. These sequences along with other available barcoding sequences for this subgenus are incorporated in a molecular analysis using the neighbor-joining (NJ) method in order to assess the efficacy of DNA barcoding for delimiting these species. Habitus and a key to all Chinese *Stegana* (s. str.) species are provided.

Key words: *COI* gene; drosophilid; taxonomy; key

中国冠果蝇属一新种和二新记录种及 DNA 条形码信息（双翅目：果蝇科）

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摘要: 基于形态学和分子遗传学证据, 描述了冠果蝇属 1 新种和 2 新记录种: *Stegana (Stegana) helvipecta* **sp. nov.**, *S. (S.) furta* (Linnaeus, 1767) 和 *S. (S.) taba* Okada, 1971; 利用 41 条 DNA 条形码信息, 分析了 18 种冠果蝇的遗传距离, 并提供了中国产全部 18 种冠果蝇的形态图及分种检索表。

关键词: *COI* 基因; 果蝇; 分类; 检索表

Introduction

Species of the subgenus *Stegana* (sensu stricto) (Meigen 1830) can be readily distinguished from those of the subgenus *Steganina* Wheeler (1960) in the main axis of eye vertical; face yellow, unicolorous; palpus large and black, with numerous small setae (Bächli *et al.* 2004; Li *et al.* 2010). Up to the present, a total of 31 *Stegana* (s. str.) species have been reported worldwide, with approximately 22 spp. recorded from East Asia, among which 17 were recorded from China (Brake & Bächli 2008; Li *et al.* 2010; Zhang *et al.* 2014, 2016). Zhang *et al.* (2016) examined the relationship among 14 species of the subgenus *Stegana* from China based on DNA sequence data of the mitochondrial *ND2* (NADH dehydrogenase subunit 2) and *COI* (cytochrome *c* oxidase, subunit I) genes after Li *et al.* 2010, which provided more DNA barcoding information for assessment of species delimitation. In this paper, one new

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species in the subgenus *Stegana* is described from Yunnan, and two known species reported from China, *S. (S.) furta* (Linnaeus, 1767) from Xinjiang and *S. (S.) taba* Okada, 1971 from Zhejiang and Fujian, are redescribed in females as new records. In addition, 41 DNA barcodes (partial sequence of the *COI* gene) of 18 species are detailed (Table 1). These sequences are employed in a molecular analysis using the neighbor-joining (NJ) method in order to assess the availability of DNA barcoding in delimiting species within this subgenus.

Material and methods

Materials and morphological terminology

All specimens examined were collected by sweeping on tree trunks or above tussocks along streams in the forest, and then preserved in 75% ethanol. Specimens are deposited in Department of Entomology, South China Agricultural University, Guangzhou, China (SCAU). An Mshot Camera (Mshot, China) microscope was used for photographing. Illustrations and line drawings were processed with the software Adobe Photoshop 7.0 and Easy Paint Tool SAI Ver.1.0.0. We followed McAlpine (1981) for morphological terminology, and Chen & Toda (2001) for the definitions of measurements, indices and abbreviations. About the abbreviations of species descriptions, see Zhang *et al.* (2014) and Li *et al.* (2019).

DNA extraction, PCR, sequencing and sequence aligning

After the dissection of male genitalia, total DNA was extracted from the abdominal tissues of selected individuals using the Magen™ DNA extraction kit (Magen, China). The *COI* fragments were amplified using the cycle protocol as in Zhao *et al.* (2009). The PCR primer pair used is 5'-CGCCTAAACTTCAGCCACTT-3' (Wang *et al.* 2006) and 5'-TAAACTTCAGGGTGACCAAAAAATCA-3' (Folmer *et al.* 1994). The GenBank accession numbers for the sequences determined are in Table 1.

Table 1. Details of the *Stegana* (s. str.) samples involved in this study (* Sequences determined in Li *et al.* 2010 or Zhang *et al.* 2014, 2016)

Species	Collection sites	GenBank accession numbers of <i>COI</i>
<i>antha</i> Zhang, Li & Chen, 2016 (♂) –1	Wangtianshu, Mengla, Yunnan	KC861375*
<i>antha</i> Zhang, Li & Chen, 2016 (♂) –2	Wangtianshu, Mengla, Yunnan	KF670978*
<i>antlia</i> Okada, 1991 (♀) –1	Wangtianshu, Mengla, Yunnan	KF670979*
<i>antlia</i> Okada, 1991 (♂) –2	Wangtianshu, Mengla, Yunnan	KF670980*
<i>antlia</i> Okada, 1991 (♂) –3	Chebaling, Shixing, Guangdong	MZ208283
<i>apiciprocera</i> Cao & Chen, 2010 (♂) –1	Wangtianshu, Mengla, Yunnan	KF670982*
<i>apiciprocera</i> Cao & Chen, 2010 (♂) –2	Beibeng, Medog, Xizang	KF670981*
<i>cheni</i> Sidorenko, 1997 (♀)	Lianhuatan, Hekou, Yunnan	MW602185
<i>emeiensis</i> Sidorenko, 1997 (♂) –1	Menglun, Mengla, Yunnan	HM636455*
<i>emeiensis</i> Sidorenko, 1997 (♂) –2	Emeishan, Leshan, Sichuan	KP752418*
<i>furta</i> (Linnaeus, 1767) (♂) –1	Xitianshan, Kurdistan, Xinjiang	MW602186
<i>furta</i> (Linnaeus, 1767) (♀) –2	Hemu, Burqin, Xinjiang	MW602187
<i>huangjiai</i> Zhang, Li & Chen, 2016 (♂) –1	Dasahe, Daozhen, Guizhou	KC861377*

Continued Table 1.

Species	Collection sites	GenBank accession numbers of COI
<i>huangjiai</i> Zhang, Li & Chen, 2016 (♂) –2	Muyu, Shennongjia, Hubei	MW602190
<i>huangjiai</i> Zhang, Li & Chen, 2016 (♀) –3	Fengtongzhai, Baoxing, Sichuan	MW602189
<i>huangjiai</i> Zhang, Li & Chen, 2016 (♂) –4	Wuliangshan, Jingdong, Yunnan	KC861376*
<i>huangjiai</i> Zhang, Li & Chen, 2016 (♂) –5	Wulaoshan, Lincang, Yunnan	MW602188
<i>latiorificia</i> Zhang, Li & Chen, 2016 (♂) –1	Wangtianshu, Mengla, Yunnan	MW602191
<i>latiorificia</i> Zhang, Li & Chen, 2016 (♀) –2	Yixiang, Pu'er, Yunnan	KF642611*
<i>nigrifoliacea</i> Zhang, Li & Chen, 2016 (♂)	Kuankuoshui, Suiyang, Guizhou	KC861378*
<i>quadrata</i> Cao & Chen, 2010 (♂) –1	Wangtianshu, Mengla, Yunnan	HQ270147*
<i>quadrata</i> Cao & Chen, 2010 (♂) –2	Simianshan, Jiangjin, Chongqing	KP179318*
<i>quadrata</i> Cao & Chen, 2010 (♂) –3	Fengtongzhai, Baoxing, Sichuan	MW602192
<i>rotunda</i> Cao & Chen, 2010 (♂) –1	Maoershan, Guilin, Guangxi	KF670986*
<i>rotunda</i> Cao & Chen, 2010 (♀) –2	Baihualing, Baoshan, Yunnan	MW602193
<i>rotunda</i> Cao & Chen, 2010 (♀) –3	Mulun, Huanjiang, Guangxi	MW602194
<i>sinica</i> Sidorenko, 1991 (♀) –1	Wanba, Jiulong, Sichuan	MW602196
<i>sinica</i> Sidorenko, 1991 (♀) –2	Wanba, Jiulong, Sichuan	MW602195
<i>sinica</i> Sidorenko, 1991 (♀) –3	Wanba, Jiulong, Sichuan	MW602197
<i>taba</i> Okada, 1971 (♀) –1	Tianmushan, Lin'an, Zhejiang	MW602198
<i>taba</i> Okada, 1971 (♀) –2	Tianmushan, Lin'an, Zhejiang	MW602199
<i>taba</i> Okada, 1971 (♀) –3	Tongmu, Wuyishan, Fujian	MZ144012
<i>taiwana</i> Okada, 1991 (♂) –1	Haoping, Qinling, Shannxi	MW602200
<i>taiwana</i> Okada, 1991 (♂) –2	Cengwanlaoshan, Tianlin, Guangxi	MW602201
<i>taiwana</i> Okada, 1991 (♂) –3	Wulu, Taidong, Taiwan	KF670987*
<i>yangi</i> Zhang, Tsaur & Chen, 2014 (♂) –1	Wulai, Xinbei, Taiwan	KC861379*
<i>yangi</i> Zhang, Tsaur & Chen, 2014 (♂) –2	Renai, Nantou, Taiwan	KC861380*
<i>zhangii</i> Sidorenko, 1997 (♂) –1	Er'pu, Lüchun, Yunnan	MW602202
<i>zhangii</i> Sidorenko, 1997 (♂) –2	Menglun, Mengla, Yunnan	KF670988*
<i>zhangii</i> Sidorenko, 1997 (♂) –3	Yixiang, Pu'er, Yunnan	KF670989*
<i>helvipecta</i> sp. nov. (♂)	Muyiji, Ximeng, Yunnan	MW602203

Species delimitation

A total of 41 barcode sequences of 18 *Stegana* species (including the 3 species described or redescribed in this study) were generated from the above-mentioned molecular experiments. 20 *COI* sequences of 12 species of *Stegana* (s. str.) obtained from related studies during the recent years (Li *et al.* 2010; Zhang *et al.* 2014, 2016) are also employed. All sequences were aligned using the ClustalW module in MEGA 5.05 (Tamura *et al.* 2011). The alignment was translated into amino acid sequences to ensure the integrity and accuracy of barcoding sequences. Intra- and interspecific pairwise *p*-genetic distances (Table 2) were calculated in MEGA 5.05. The sequence alignment was subsequently employed to reconstruct an NJ tree with *p*-distance model implemented in MEGA 5.05. Bootstrap percentages (BPs) were inferred for nodes with 1000 replicates.

Results

The intra- and interspecific *p*-distances are summarized in Table 2. The intraspecific distances ranged from 0.000 to 0.029, with an average of 0.010, and a standard deviation (SD) of 0.010. The interspecific distances range from 0.039 [between *S. (S.) antha* and *S. (S.) latiorificia*] to 0.165 [between *S. (S.) antlia* and *S. (S.) sinica*], with an average of 0.106, and a SD (standard error) of 0.025. The new species, *S. (S.) helvipecta* is separated from all the other species involved by a substantial *p*-distance (> 0.087). The NJ tree (Fig. 1) indicated that the monophyly of all sampled *Stegana* morphospecies was supported.

Table 2. *p*-distances within and between 39 *COI* sequences of 18 *Stegana* (s. str.) species involved in the genetic analysis

Species	Number of sequences	Min. intra./Max. intra. /Mean intra. Vari.	Min. Inter./Max. Inter. /Mean Inter. Vari.	Species with Min. inter
<i>antha</i>	2	0.003/0.003/0.003±0.000	0.039/0.149/0.123±0.025	<i>latiorificia</i>
<i>antlia</i>	2	0.000/0.000/0.000±0.000	0.074/0.165/0.132±0.023	<i>latiorificia</i>
<i>apiciprocera</i>	2	0.003/0.003/0.003±0.000	0.058/0.136/0.094±0.024	<i>emeiensis</i>
<i>cheni</i>	1	NA/NA/NA	0.060/0.128/0.092±0.022	<i>yangi</i>
<i>emeiensis</i>	2	0.010/0.010/0.010±0.000	0.058/0.137/0.098±0.020	<i>apiciprocera</i>
<i>furta</i>	2	0.000/0.000/0.000±0.000	0.086/0.115/0.101±0.007	<i>nigrifoliacea</i>
<i>huangjiai</i>	5	0.000/0.029/0.018±0.010	0.068/0.145/0.103±0.024	<i>quadrata</i>
<i>latiorificia</i>	2	0.024/0.024/0.024±0.000	0.039/0.141/0.115±0.023	<i>antha</i>
<i>nigrifoliacea</i>	1	NA/NA/NA	0.086/0.142/0.114±0.011	<i>furta</i>
<i>quadrata</i>	3	0.000/0.011/0.008±0.005	0.050/0.136/0.096±0.025	<i>yangi</i>
<i>rotunda</i>	3	0.010/0.026/0.017±0.007	0.089/0.157/0.117±0.015	<i>emeiensis</i>
<i>sinica</i>	3	0.000/0.003/0.002±0.002	0.102/0.165/0.130±0.013	<i>furta</i>
<i>taba</i>	2	0.000/0.000/0.000±0.000	0.084/0.141/0.105±0.017	<i>taiwana</i>
<i>taiwana</i>	3	0.000/0.006/0.004±0.003	0.052/0.131/0.091±0.024	<i>zhang</i>
<i>yangi</i>	2	0.003/0.003/0.003±0.000	0.050/0.141/0.094±0.028	<i>quadrata</i>
<i>zhang</i>	3	0.002/0.005/0.003±0.001	0.052/0.144/0.093±0.025	<i>taiwana</i>
<i>helvipecta</i> sp. nov.	1	NA/NA/NA	0.087/0.158/0.115±0.017	<i>taba</i>
Total	39	0.000/0.029/0.010±0.010	0.039/0.165/0.106±0.025	

Min. intra., minimum intraspecific distance; Max. intra., maximum intraspecific distance; Mean intra. Vari., mean intraspecific variability (standard deviation, SD); Min. inter., minimum interspecific distance; Max. inter., maximum interspecific distance; Mean inter. Vari., mean interspecific variability (SD); NA, not applicable.

Taxonomy

Stegana (s. str.) Meigen

Stegana Meigen, 1830: 97. Type species: *Masca furta* Linnaeus, 1767: 991.

Diagnosis. Longest axis of eye rectangular to body axis (Figs 2–5); face yellow, unicolorous; palpus large and black, with numerous small setae (Figs 2–5) (modified from Bächli *et al.* 2004).

Description. Male and female. Eyes red. Ocellar triangle black, with a pair of small setae above ocellar setae. Postvertical setae located slightly behind vertex ridge. Frons yellow to

black, with several minute setulae medially. Proclinate orbital setae nearer to ptilinal fissure than to inner vertical setae. Pedicel yellow; arista plumose. Lunule brown to black. Facial carina absent. Gena yellowish brown, black at vibrissa corners. Vibrissa prominent; other orals small. Occiput glossy, yellow, black around occipital foramen. Thorax dorsally yellow to black, usually with longitudinal stripes (Figs 2–5). Mesopleuron with a black longitudinal stripe above (running from propleuron to base of halter) (Figs 2–5). Katepisternum usually yellow, with a brown to black longitudinal stripe above (Figs 2–5). Postpronotal lobe with 1 long and a few short setae. Acrostichal setulae in approximately 10 irregular rows. Prescutellar setae 1 pair. Scutellum basal setae divergent, apical setae cruciate. Wing dark brown anteriorly, paler posteriorly, yellowish at tip; curved downward on distal part. Basal medial-cubital crossvein present; C_1 setae 2, less differentiated. Costal vein with 6–8 minute spinules on ventral surface between R_{2+3} and R_{4+5} . R_{2+3} markedly curved to costa at tip; R_{4+5} and M_1 veins convergent distally. Halteres white. Foreleg femur with 1 row (4–6) of setae on ventral surface. Apical seta present on mid tibia. Preapical dorsal setae present on all tibiae. Mid tarsus with 5 or 6 strong setae on basal part of dorsal surface. Mid and hind tarsomeres with 2 and 1 row(s) of minute cuneiform setulae on ventral surface, respectively; fore and hind tarsomeres I slightly shorter than the rest combined; mid tarsomere I longer than the rest combined. Abdominal tergites yellow to black (Figs 2–5), abdominal sternites yellow to brown, broadened, wider than long.

Male terminalia. Epandrium pubescent except for anterior margin, with numerous setae on dorsal to posterolateral portion per side and (Figs 6A, 8A). Surstylus anterodorsally fused with epandrium, with several setae on outer surface (Figs 6B, 8B). Cercus separated from epandrium, setigerous, mostly lacking pubescence (Figs 6A, 8A). Hypandrium anteromedially protruded or broadened (Figs. 6C, 8C). Parameres mostly developed (Figs 8C, 8D), sometimes minute or inconspicuous (Figs 6C, 6D). Aedeagus mostly with tentacle-like setae distally (Figs. 6C, 8C). Aedeagal apodeme strong, contiguous to base of aedeagus (Figs 6C, 6D, 8C, 8D). Gonopods fused to each other, forming posteromedian lobe, strongly sclerotized, posterolaterally contiguous to posterior ends of hypandrium (Figs 6E, 6F, 8E, 8F).

1. *Stegana (Stegana) furta* (Linnaeus, 1767) (Figs 3A, 3B, 6)

Masca furta Linnaeus, 1767: 991.

Drosophila curvipennis Fallén, 1823: 4.

Stegan nigra Meigen, 1830: 79.

Description. For the detailed morphology in the male of this species, see Bächli *et al.* (2004). Female terminalia (Figs 6H–J): epiproct with 2 setae only; cercus with dense setae, lacking pubescence. Hypoproct entirely pubescent, with dense setae. Eighth sternite glabrous on basal 1/2 region, with a few setae on distal 1/2 region, lacking pubescence.

Measurements and indices. BL = 2.75–3.09 mm in 3♂, 2.61–3.74 mm in 5♀, ThL = 1.26–1.42 mm in ♂, 1.24–1.62 mm in ♀, WL = 2.39–2.81 mm in ♂, 2.43–3.32 mm in ♀, WW = 1.09–1.26 mm in ♂, 1.07–1.57 mm in ♀, arb = 3–4/5–6, avd = 0.79–1.28, adf = 0.76–1.33, flw = 1.73–2.29, FW/HW = 0.29–0.41, ch/o = 0.22–0.25, prorb = 0.17–0.37, rcorb = 0.57–0.86, vb = 0.40–0.86, dcl = 0.42–0.75, presctl = 0.45–0.68, sctl = 1.45–2.66, sterno = 0.67–1.59, orbito = 1.66–2.13, dcp = 0.26–0.38, sctlp = 1.18–1.67, C = 1.92–2.19, 4c = 1.14–1.36, 4v = 1.81–2.14, 5x = 0.93–1.68, ac = 6.12–7.79, M = 0.48–0.77, C3F = 0.59–0.65.

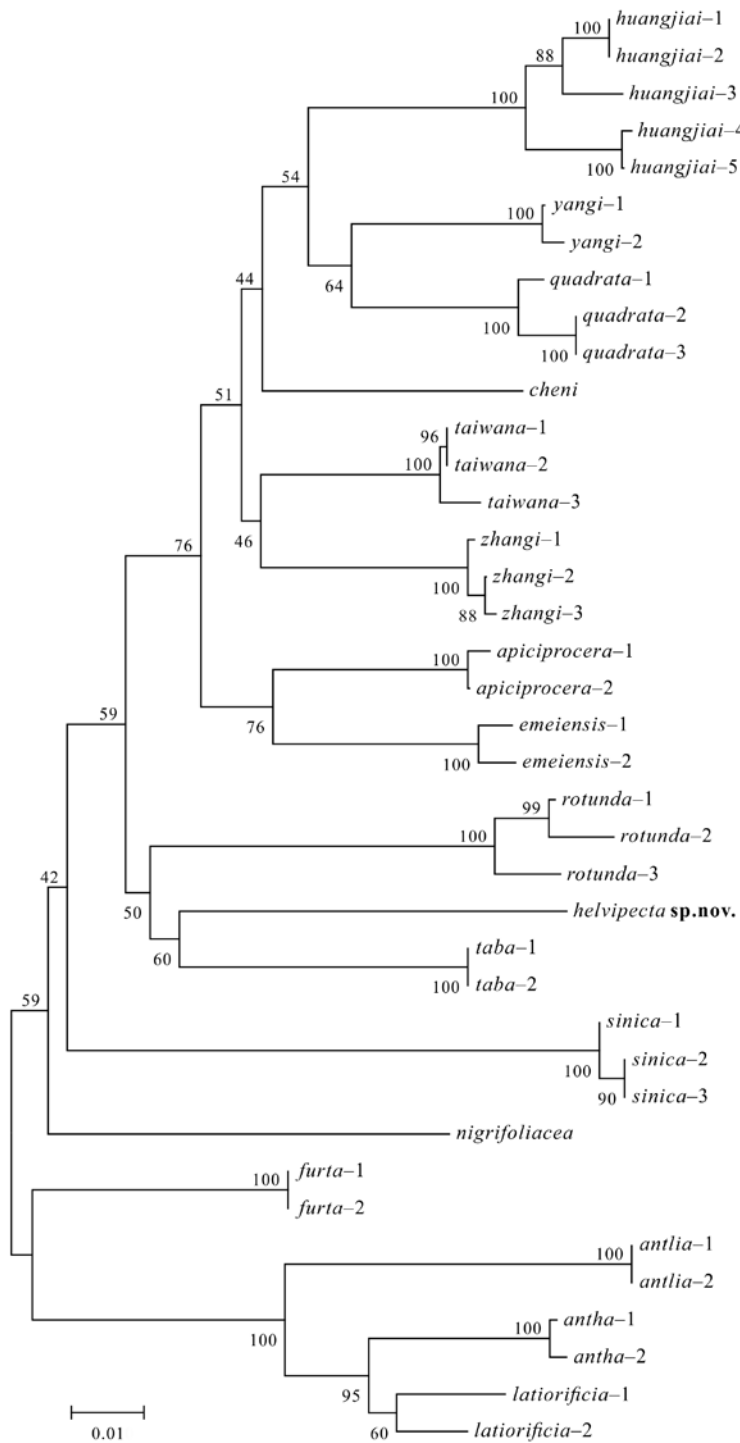


Figure 1. Neighbor-joining (NJ) tree of barcodes. Numbers around the nodes are bootstrap percentage (BP) values (not shown if lower than 50).

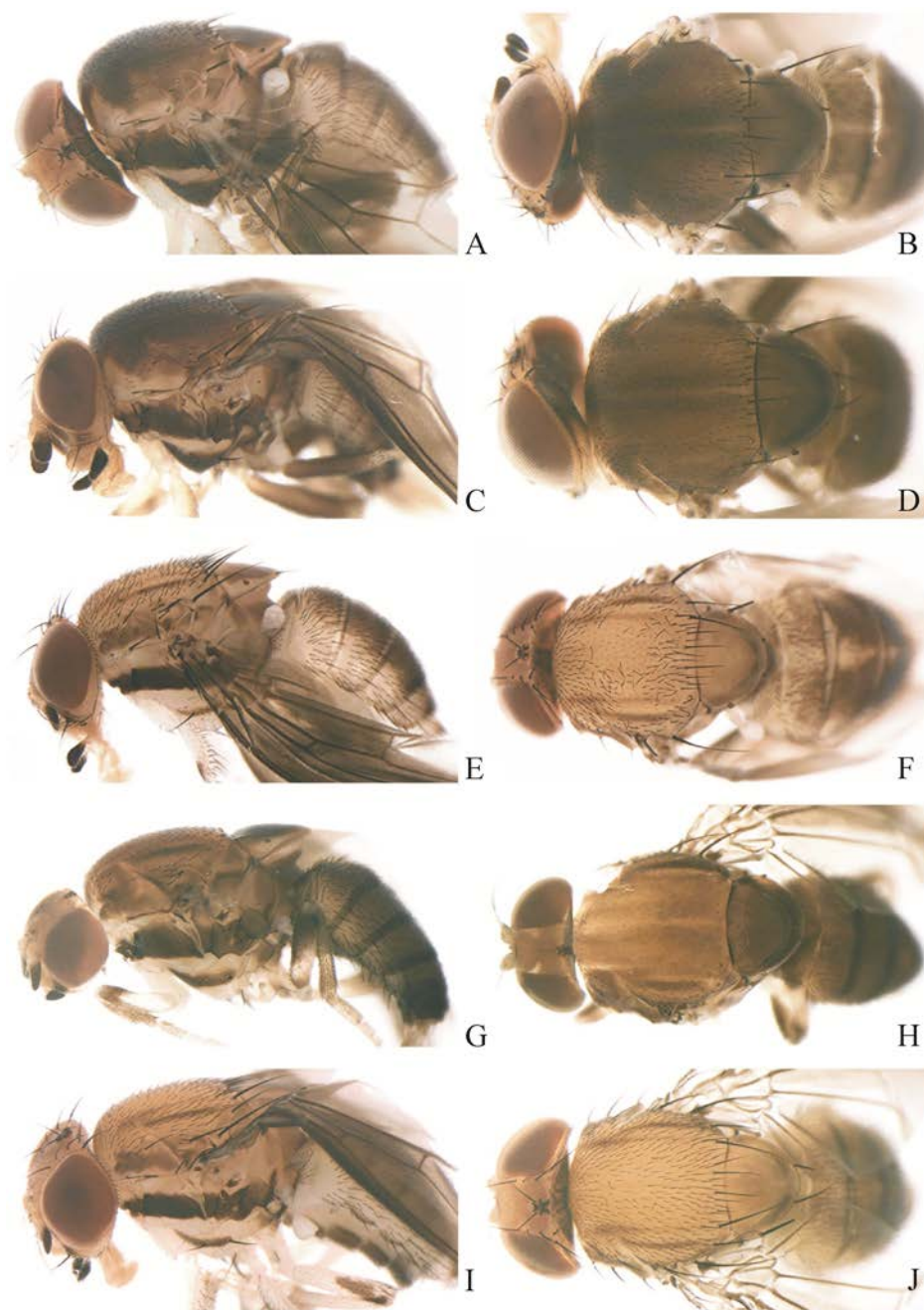


Figure 2. Habitus. A, B. *Stegana (Stegana) antha* Zhang, Li & Chen, 2016; C, D. *Stegana (Stegana) antlia* Okada, 1991; E, F. *Stegana (Stegana) apiciprocera* Cao & Chen, 2010; G, H. *Stegana (Stegana) cheni* Sidorenko, 1997; I, J. *Stegana (Stegana) emeiensis* Sidorenko, 1997.

Specimens examined. China, 2♂7♀ (SCAU, DIP 112046-54), Xitianshan, Kurdistan, Xinjiang, 43°13'48"N, 82°54'16"E, alt.1310 m, 03–07-VII-2018, ex tussock, Hongwei CHEN; 1♂6♀ (SCAU, DIP 112055-61), Hemu, Burqin, Xinjiang, 48°26'31"N, 87°19'12"E, alt.1070 m,

12-VII-2018, ex tussock, Hongwei CHEN.

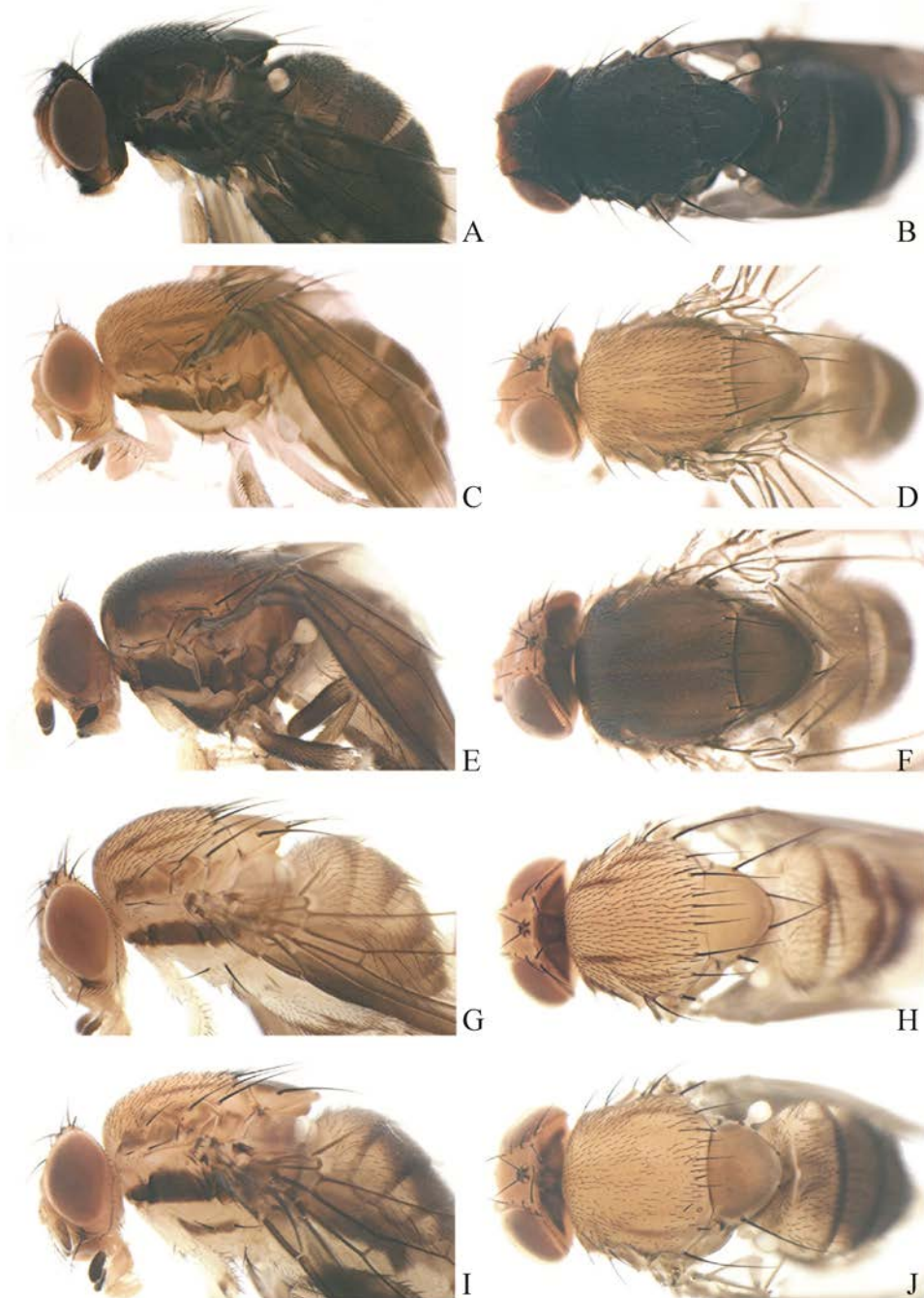


Figure 3. Habitus. A, B. *Stegana* (*Stegana*) *furta* (Linnaeus, 1767); C, D. *Stegana* (*Stegana*) *huangjiai* Zhang, Li & Chen, 2016; E, F. *Stegana* (*Stegana*) *latiorificia* Zhang, Li & Chen, 2016; G, H. *Stegana* (*Stegana*) *nigrifoliacea* Zhang, Li & Chen, 2016; I, J. *Stegana* (*Stegana*) *quadrata* Cao & Chen, 2010.

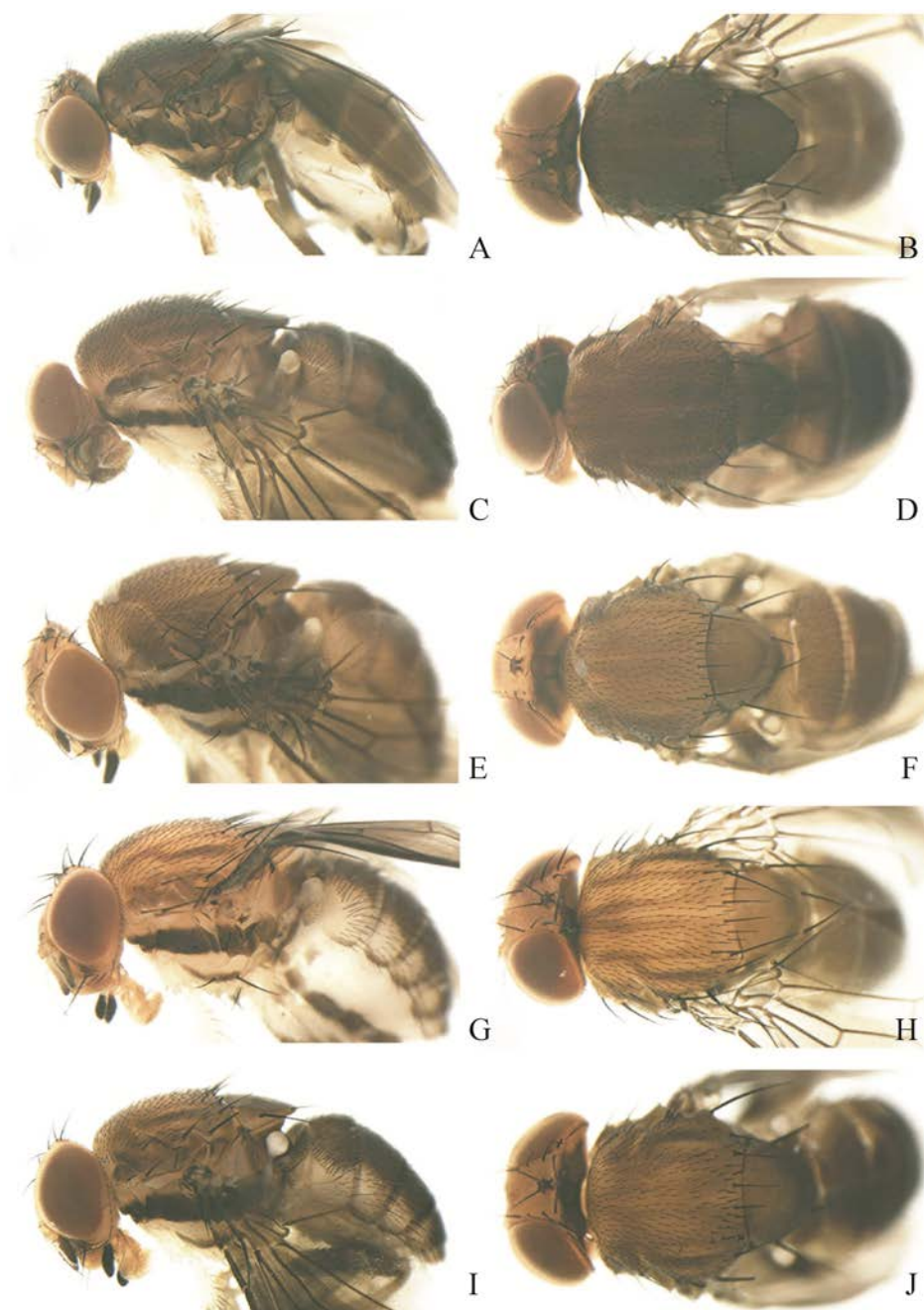


Figure 4. Habitus. A, B. *Stegana (Stegana) rotunda* Cao & Chen, 2010; C, D. *Stegana (Stegana) sinica* Sidorenko, 1991; E, F. *Stegana (Stegana) taba* Okada, 1971; G, H. *Stegana (Stegana) taiwana* Okada, 1991; I, J. *Stegana (Stegana) yangi* Zhang, Tsaur & Chen, 2014.

Distribution. China (Xinjiang); Russia; Mongolia; Kazakhstan; Europe.

Diagnosis. This species resembles *S. sinica* Sidorenko, 1991 (in Sidorenko & Okada 1991) in the male terminalia, but can be distinguished by the thorax entirely black (Figs 3A, 3B), and

gonopods round apically (Fig. 6E). The *p*-distance between the two species is larger than 10.20% (Table 2).

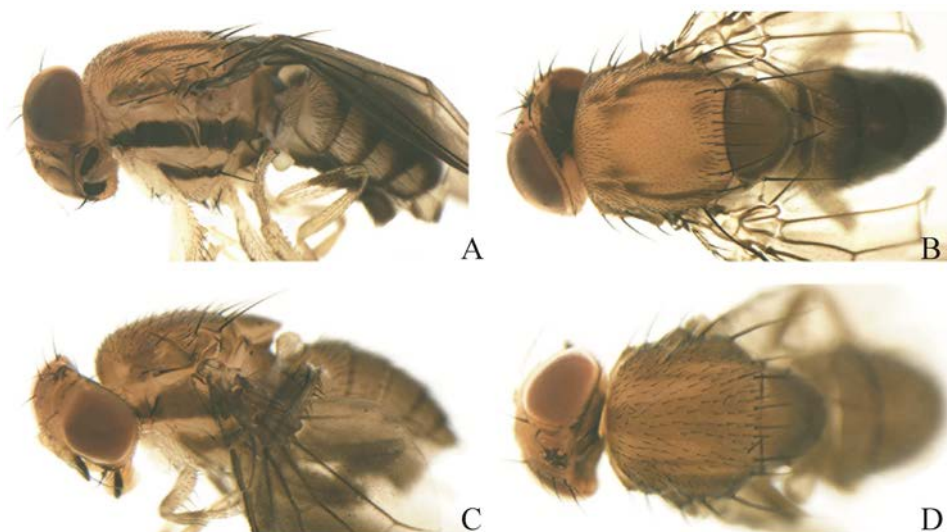


Figure 5. Habitus. A, B. *Stegana (Stegana) zhangi* Sidorenko, 1997; C, D. *Stegana (Stegana) helvipecta* Cui, Li & Chen, **sp. nov.**

2. *Stegana (Stegana) taba* Okada, 1971 (Figs 4E, 4F, 7)

Stegana (Stegana) taba Okada, 1971: 87.

Description. For the detailed morphological characters of this species see Okada (1971). Female terminalia (Figs 7H–J): epiproct with a few of setae along posterior margin; cercus with dense setae, lacking pubescence. Hypoproct entirely pubescent, with dense setae on basal 1/2 region. Eighth sternite glabrous on basal 1/3 region, with a few of setae on distal 1/3 region, lacking pubescence.

Measurements and indices. BL = 2.69–2.74 mm in 2♀, ThL = 1.35–1.43 mm in ♀, WL = 2.67–2.71 mm in ♀, WW = 1.04–1.13 mm in ♀, arb = 6–6/8–9, avd = 0.67–0.81, adf = 1.56–1.68, flw = 2.26–2.51, FW/HW = 0.34–0.36, ch/o = 0.24–0.31, pror = 0.27–0.30, rcorb = 0.76–0.85, vb = 0.69–0.87, dcl = 0.56–0.63, presctl = 0.65–0.75, sctl = 1.75–2.46, sterno = 1.06–1.17, orbito = 1.67–1.86, dcp = 0.30–0.32, sctlp = 1.47–1.53, C = 1.88–1.89, 4c = 1.28–1.38, 4v = 2.01–2.04, 5x = 1.17–1.24, ac = 6.80–8.42, M = 0.62–0.69, C3F = 0.61–0.63.

Specimens examined. China, 2♀ (SCAU, DIP 111956, 57), Tongmu, Wuyishan, Fujian, 27°54'33"N, 117°51'54"E, alt. 580–800 m, 15–18-VIII-2001, tree trunks, Hongwei CHEN; 2♀ (SCAU, DIP 111937, 38), Western Tianmushan, Lin'an, Zhejiang, 30°20'N, 119°25'E, alt. 1100 m, 01-VIII-2011, ex tussock, Zenfang SHAO, Sujuan YAN.

Distribution. China (Zhejiang, Fujian); Far East Russia; Japan; Korea.

Diagnosis. This species resembles *S. cheni* Sidorenko, 1997 in the male terminalia (figs 40, 41 in Okada 1971; figs 7–9 in Zhang *et al.* 2016), but can be distinguished from the latter by surstylus with 2 prensisetae (1 prensiseta in *S. cheni*), the aedeagus distolaterally lacking small processes on each side (2–3 in *S. cheni*). The *p*-distance between the two forms is 8.40% (Table 2).

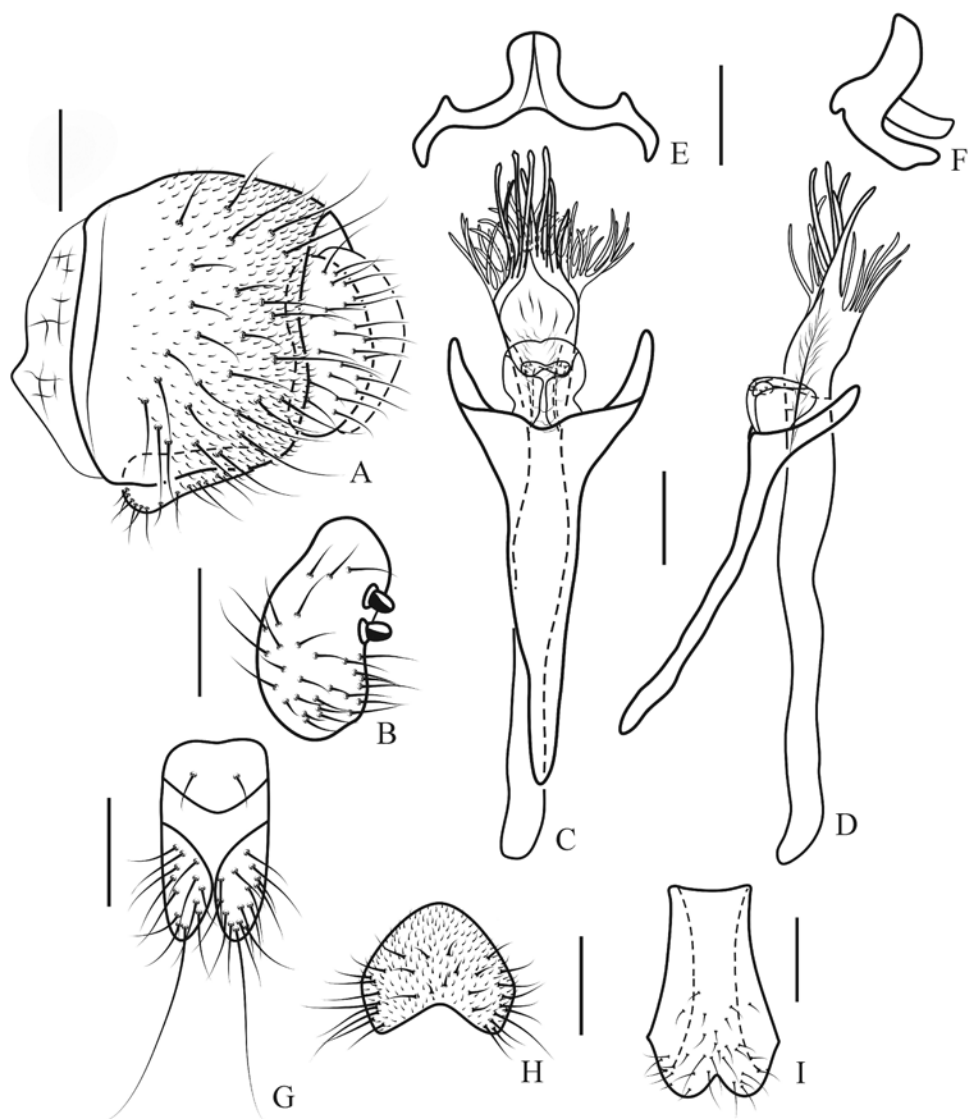


Figure 6. *Stegana (Stegana) furta* (Linnaeus, 1767), male and female terminalia. A. Epandrium, surstylus and cercus, lateral view; B, C. Hypandrium, parameres, aedeagus and aedeagal apodeme, ventral and lateral views; D, E. Gonopods, ventral and lateral views; G. Epiproct and cercus; H. Eighth sternite; I. Hypoproct. Scale bars = 0.1 mm.

3. *Stegana (Stegana) helvipecta* Zhang & Chen sp. nov. (Figs 5C, 5D, 8)

Description. Male: frons and face yellow. First flagellomere yellow on basal 1/3, black on distal 2/3. Clypeus brown. Palpus yellow. Mesonotum brownish, with 4 yellow longitudinal stripes (Fig. 5D). Katepisternum yellowish, with brown longitudinal stripe above (Fig. 5C). Scutellum brown, dark along margin (Fig. 5D). Femur of foreleg with 3 or 4 long erect setae near distal part of posteroventral surface. Abdominal tergites nearly brown (Fig. 5D). Male terminalia (Fig. 8): epandrium slightly protruded ventrally, with ca. 16 setae on posterior portion per side. Surstylus slightly oval, with several setulae. Cercus lacking pubescence.

Hypandrium slightly triangularly expanded. Aedeagus subbasally expanded in ventral view, with 10 spine-like processes laterally and numerous tentacle-like setae along peristome. Gonopods apically pointed and curved ventrad, basolaterally curved dorsad.

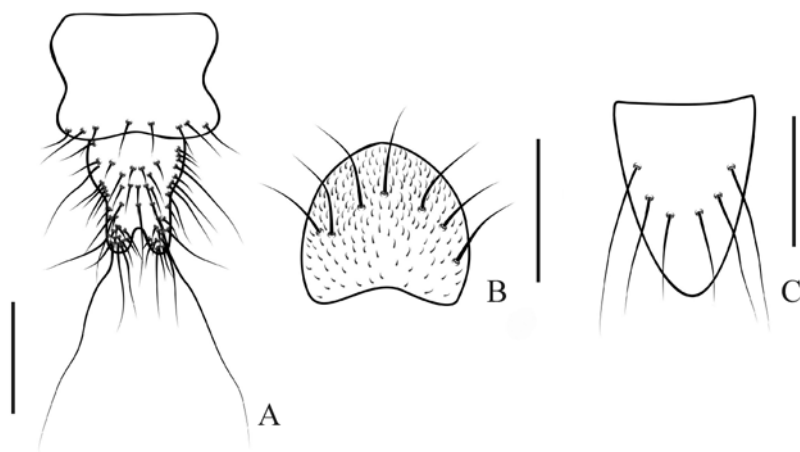


Figure 7. *Stegana* (*Stegana*) *taba* Okada, 1971, female terminalia. A. Epiproct and cercus; B. Eighth sternite; C. Hypoproct. Scale bars = 0.1 mm.

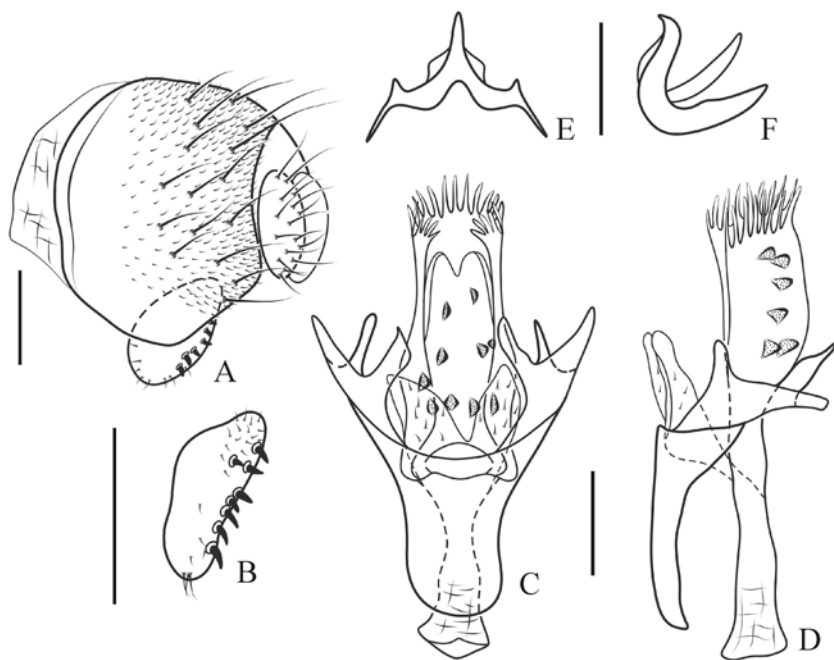


Figure 8. *Stegana* (*Stegana*) *helvipecta* Cui, Li & Chen, **sp. nov.**, male terminalia. A. Epandrium, surstylus and cercus, lateral view; B. Surstylus, inner view; C, D. Hypandrium, parameres, aedeagus and aedeagal apodeme, ventral and lateral views; E, F. Gonopods, ventral and lateral views. Scale bars = 0.1 mm.

Measurements and indices. BL = 2.08 mm, THL = 0.89 mm, WL = 1.89 mm, WW = 0.94 mm, arb = 4/6, avd = 1.08, adf = 1.23, flw = 2.29, FW/HW = 0.35, ch/o = 0.38, prorb = 0.17, rcorb = 0.54, vb = 0.45, dc1 = 0.69, presct1 = 0.53, sct1 = 2.06, sterno = 0.60, orbito = 2.00, dcp = 0.38, sct1p = 1.23, C = 1.61, 4c = 1.44, 4v = 2.02, 5x = 1.29, ac = 6.00, M = 0.72, C3F = 0.65.

Holotype. ♂ (SCAU, No. 121098), **China**, Muyiji Park, Ximeng, Yunnan, 22°37'15"N, 99°35'42"E, alt. 1203 m, 03-V-2016, ex tussock, Jia HUANG.

Etymology. The specific epithet is combination of the Latin words “*helvolus*” (= yellowish) and “*pectus*” (= thorax), referring to the mesonotum being mostly yellow.

Diagnosis. This species differs from the other species in this subgenus in having the surstylus with numerous (7–9) prensisetae (Fig. 8B); parameres nearly separated from each other, with a few sensilla (Figs 8C, 8D). The interspecific genetic distance to *S. taba* Okada, 1971 is 3.90%, which is smaller than to other species (Table 2).

Key to all species of the subgenus *Stegana* from China (male)

1. Parameres minute or inconspicuous (Figs 6C, 6D) 2
- Parameres distinctly rod- or lob-like (Figs 8C, 8D) 3
2. Thorax entirely black (Figs 3A, 3B); gonopods round apically (Fig. 6E) *S. furta* (Linnaeus)
- Mesoscutum dark brown, with 5 yellowish brown longitudinal stripes (Fig. 5D); katapisternum entirely yellow (Fig. 5C); gonopods triangular apically (fig. 2 in Sidorenko & Okada 1991) *S. sinica* Sidorenko
3. Parameres fused with each other 4
- Parameres entirely separated from each other 14
4. Parameres strongly sclerotized, nearly black, fused to each other on distal two-thirds, with a few sensilla on basal third (figs 25, 26 in Li *et al.* 2010); aedeagus with ca. 16 pairs of short, rod-like processes apically (figs 25, 26 in Li *et al.* 2010) *S. polyrhopalina* Cao & Chen
- Parameres usually not sclerotized, yellow, fused each other basally, distally separated from each other, with long setae; aedeagus with tentacle-like setae 5
5. Parameres fused to each other on basal 1/4 only 6
- Parameres fused to each other on basal half 8
6. Surstylus with ca. 7–9 strong prensisetae (Figs 8A, 8B); paramere with minute sensilla only, lacking long seta apically (Figs 8C, 8D) *S. helvipecta* **sp. nov.**
- Surstylus with 1 or without strong prensiseta (fig. 3B in Zhang *et al.* 2014; fig. 19 in Zhang *et al.* 2016); paramere with 1 long seta apically besides several minute sensilla (fig. 3E in Zhang *et al.* 2014; fig. 20 in Zhang *et al.* 2016) 7
7. Mesoscutum and scutellum yellow (Figs 3C, 3D); aedeagus strongly sclerotized ventrally (figs 20, 21 in Zhang *et al.* 2016) *S. huangjiai* Zheng, Li & Chen
- Mesoscutum and scutellum brown to dark brown (Figs 4I, 4J); aedeagus slightly sclerotized along margin (fig. 3E in Zhang *et al.* 2014) *S. yangi* Zhang, Tsaur & Chen
8. Aedeagus with spine-like processes 6
- Aedeagus with only minute, serrated processes 7
9. Parameres with 2 triangular processes between them (tp; fig. 13 in Zhang *et al.* 2016); aedeagus curling ventrad laterally (fig. 13 in Zhang *et al.* 2016) *S. emeiensis* Sidorenko
- Parameres without triangular processes between them (fig. 39 in Li *et al.* 2010); aedeagus not curling ventrad laterally (fig. 39 in Li *et al.* 2010) *S. rotunda* Cao & Chen
10. Surstylus lacking strong prensiseta (fig. 2 in Li *et al.* 2010; fig. 2B in Zhang *et al.* 2014) 11
- Surstylus with 1 strong prensiseta 12
11. Paramere with 1 long seta (figs 2D, 2E in Zhang *et al.* 2014); aedeagus expanded ventrad laterally (figs 2D,

- 2E in Zhang *et al.*, 2014); gonopods distally nearly triangular (fig. 2C in Zhang *et al.* 2014) *S. taiwana* Okada
- . Paramere with 2–3 long setae (figs 4, 5 in Li *et al.* 2010); aedeagus not expanded ventrad laterally (fig. 5 in Li *et al.* 2010); gonopods with 3 subequal processes medially and submedially (fig. 3 in Li *et al.* 2010) *S. zhangii* Sidorenko
12. Surstylus with 1 apically pointed prensiseta on posterior corner (fig. 3 in Zhang *et al.* 2016); aedeagus black basally, with 4–5 pairs of spine-like processes along median portion (figs 4, 5 in Zhang *et al.* 2016) *S. antlia* Okada
- . Surstylus with 1 apically rounded prensiseta on outer surface (figs 15, 23 in Zhang *et al.* 2016); aedeagus not black, with numerous minute, serrated processes along peristome (figs 16, 24 in Zhang *et al.* 2016) 13
13. Aedeagal opening nearly round in ventral view (fig. 16 in Zhang *et al.* 2016); scutum dark brown anteriorly, brown posteriorly; abdominal tergites brown medially and yellow laterally *S. antha* Zhang, Li & Chen
- Aedeagal opening oval in ventral view (fig. 24 in Zhang *et al.* 2016); scutum and abdominal tergites almost dark brown *S. latiorificia* Zhang, Li & Chen
14. Surstylus with several processes along apical margin, without prensiseta (fig. 27 in Zhang *et al.* 2016); aedeagus almost entirely sclerotized (figs 27, 28 in Zhang *et al.* 2016); gonopods expanded ventrad and nearly entirely surrounded by aedeagus (figs 27, 28 in Zhang *et al.* 2016) *S. nigrifoliacea* Zhang, Li & Chen
- . Surstylus with 1 or 2 strong prensiseta on outer surface, without processes; aedeagus laterally sclerotized at most; gonopods not expanded ventrad 15
15. Surstylus with 2 prensisetae (fig. 41 in Okada 1971) *S. taba* Okada
- . Surstylus with only 1 prensiseta 16
16. Paramere entirely pubescent, lacking setae (fig. 11 in Li *et al.* 2010); aedeagus apically protruded posteromedially (fig. 11 in Li *et al.* 2010) *S. apiciprocera* Cao & Chen
- . Paramere with long setae, lacking pubescence; aedeagus apically rounded or flat at posteromedian portion 17
17. Aedeagus strongly sclerotized, with narrow, membranous margin on distal third, with strongly sclerotized medial and lateral ridges on basal two-thirds, lacking spine-like processes (fig. 9 in Zhang *et al.* 2016) *S. cheni* Sidorenko
- . Aedeagus only sclerotized laterally, lacking median ridge, with numerous spine-like processes 18
18. Mesonotum dark brown to black medially, brown laterally, with 5 yellow stripes medially to sublaterally; aedeagal peristome broadened, oval in ventral view (fig. 18 in Li *et al.* 2010) *S. multispinata* Cao & Chen
- . Mesonotum yellow, with 4 black stripes submedially and laterally, submedial pair ruptured on posterior third; aedeagal peristome narrow, small aperture-like in ventral view (fig. 19 in Li *et al.* 2010) *S. quadrata* Cao & Chen

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